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AUSTRALIAN WAR MEMORIAL
ACCESS STATUS

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Reprinted from the Journal of the Royal Army Medical Corps,
December, 1936.



LONDON: JOHN BALE,
SONS & DANIELSSON,
Ltd., OXFORD HOUSE,
83-91, GT. TITCHFIELD
STREET, W.1.

WHAT MEDICINE OWES TO WAR AND WAR OWES TO
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By MAJOR-GENERAL R. M. DOWNES, C.M.G., V.D.,
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PRESIDENTIAL addresses in this Branch have sometimes covered professional subjects of especial interest to the speaker, sometimes matters of import to the organization, economics or standing of the profession, sometimes a review of the happenings and tendencies of his year of office, and occasionally matters of history. It might have been thought that in such an epochal year of our Branch history a survey of what the recent annual meeting of the Association has meant to us and will do for us would be the most appropriate theme; but I felt that a little more time would make the repercussions more definite, and, furthermore, that perhaps we have earned a slight respite from medical politics. So I thought the more readily to interest the stout few who always form the audience at these annual occasions by some story concerning the subject that now is my chief interest—the Medical Services of the Army and Air Force—and in the brief period that has been available to find such a story in this year of grace, I decided that it might be profitable to review the influence of war and medicine on each other.

As Sherman, and no doubt millions of others, said: "War is hell"; nevertheless it is a biological necessity that has to be faced, and the history of the human race is largely written in war. What knowledge did our craft forefathers and what do we, the descendants of Æsculapius, owe to war, and what has the same army of healers done to make the waging of war more possible?

First of all we should from its earliest known beginnings trace as carefully as possible the evolution of the great complicated machine which now serves the health of soldiers in the field, but time will not permit of doing this in detail. Let us, however, take notice of the growth of this machine from a feeble thing of few parts in which the personality, intellect and character of the individual was the dominant factor, to the complicated organization of mutually dependent workers that with much oiling by experience has become the more or less smoothly running engine—a modern army medical service. In the past names such as Theodoric, Paré, Larrey and McGrigor stand out in their periods as men to be wondered at; yet the lot of their sick and wounded could not be compared

¹ An address read at the Annual Meeting of the Victorian Branch of the British Medical Association on December 4, 1935. This article has appeared in the *Medical Journal of Australia* and is published here by permission of the editor of that Journal.

M.A. Vol. I 1936 Jan. 16 p. 73.

with that of their successors in the last Great War. The individuals responsible for this improvement, however, are so many and of such equal achievement that no single man could win that fame that permits his name to go down among the great in history.

As long as mankind has existed there has certainly been war; war means wounds and wounds mean people to treat them. The earliest evidence of treatment, going back almost to the first known writing in history, is found in one of the most fascinating and delightful documents any student of history could hope for, the Edwin Smith papyrus. Named after its discoverer, who obtained it at Luxor in Upper Egypt in 1862, it lay undeciphered until 1928, when it was published.² It is a copy by an unknown physician of the eighteenth dynasty in the seventeenth century B.C. of the surgical treatise of the Pyramid Age, written at least one thousand years earlier. There is some reason to conjecture that the author may have been the first known physician, Imhotep, a great personality of the third dynasty, about 3000 B.C., who after his death was deified and worshipped by the Greeks as Asklepios, by the Romans as Esculapius, the God of Healing. He was high priest, vizier, architect and philosopher to the great King Zoser of that dynasty. From his description of cases, it is obvious that he followed the wars. His methods of treatment were founded on observation and thought, and are in sharp contrast to those of his unknown copyist of some 1,300 years later, whose principles of treatment appearing in the same document depend on incantations, charms, magic and weird medicaments. All of the fifty-eight cases described are dealt with in most orderly fashion—first the title, then the examination, followed by the diagnosis, treatment, and in some cases, a glossary of the meaning of terms that had gone out of use in the intervening years. The wounds and injuries are described in order from the head downwards, while in the different areas superficial and slight wounds precede those penetrating more deeply. It is interesting to note that surgical operations were considered only as part of the examination, nothing that did not include application of medicaments being dignified as treatment. In all cases a decision as to its possible cure is given in one of the formulae "an ailment that I will treat," "an ailment with which I will contend," or "an ailment not to be treated." Imhotep knew something of cerebral localization to the opposite side of the brain, of the spine as a nervous centre, of the existence of a cardiac system and the pulse, and was very close to a knowledge of the circulation of the blood. He dissected, made use of his finger as a probe, describes what can be recognized as tetanus, and depended on Nature considerably for cure. Some of the methods, which make us wonder whether anything is new, will be mentioned as we go along.

We next learn of what corresponds to our present-day regimental

² It is a sad coincidence that we read in the cablegrams of the death of the translator, the famous Egyptologist, Breasted.

medical officers in the Trojan War, about 1200 B.C. Again Hippocrates in the fifth century B.C. alludes to them several times, one being his son, Thessalus. The Romans, however, until much later, made no use of physicians in their armies, apart from those whom the commanders or other officers took into the field for their private use. Pliny says that they were none the worse off for the lack. It appears that about the first century B.C. they established a regular medical service consisting of both physicians and tents for the sick, the latter forming hospitals or *valetudinaria*, the ruins of one of which are found in a camp of the first century A.D. The first record of the forerunner of the modern field ambulance is in the Roman Army in the sixth century; after that they seem to have gone out of fashion for some centuries. While Henry of Navarre at the end of the sixteenth century established "portable hospitals" in addition to "fixed hospitals," the former being christened "ambulances," they do not appear in British history till the wars of William III and Mary, when they were called "marching and flying hospitals" and included springed ambulance wagons. They disappeared, however, after Marlborough's campaigns which ended in 1711 until the nineteenth century, when McGrigor persuaded Wellington, in the Peninsular War, to allow him to form regimental in addition to base hospitals. Napoleon's great surgeon, Larrey, had, however, reintroduced "flying ambulances" a few years earlier. His ambulance cadre, or division comprising a personnel of 840 and including 12 light and 4 heavy cars, was ahead of anything of the kind in any war, even including the South African, up to the Great War. In these the wounded after Eylau in 1807 were transported to châteaux more than fifty-five leagues distant. There was little advance in the English Army in the Crimea, nor till the South African War, when "bearer companies" and "field hospitals" came into being. The next step was in their amalgamation after this war into field ambulances, which have undergone considerable modification and additions both during and since the Great War (be it noted that a similar name was given a century earlier to the Napoleonic Wars) into units which provide for operative and medical treatment, as well as wheeled motor transport for the sick and wounded from the battlefield. The former fixed hospitals are now known as general hospitals, while an intermediate casualty clearing station has been introduced and convalescent depôts for the healed. The springless carts for the wounded have grown into motor ambulance convoys, hospital trains, hospital barges, hospital ships and aeroplane ambulances. These, with units for bacteriological and chemical examination, for the supply of every variety of medical and surgical equipment and the manufacture of splints, make up the modern army medical service.

Contrast the few lone physicians of earliest history with the mobilization, almost complete, of the whole medical profession of Great Britain, Germany and France, and the hundreds of thousands of rank and file of the last war.

My purpose is to review whatever knowledge in the art of healing and in prevention of disease has come from the long pageant of Army physicians. Since soldiers in the main are the pick of the community, young and healthy, and through their calling prone to injuries, it is natural that surgery is the branch of medicine that has most benefited, and traumatic surgery in particular. In fact nearly all early surgery was war surgery, and very little advance was made apart from war. In England at least, training in surgery was obtainable only in war until the middle of the eighteenth century, when civil hospitals became numerous. The charter of the Royal College of Surgeons of Ireland includes "for the purpose of training surgeons for His Majesty's Army."

It is not possible in this paper to survey in any detail the progress of military surgery, but it is noticeable how periods of enlightenment were followed by those of ignorance, and how often discoveries are rediscovered. One may cite Larrey, who practised excision of wounds, a practice now looked on as probably the greatest surgical advance of the last war. Then at the beginning of the nineteenth century ulcers of the leg were a great cause of invalidism in the Army till an Army surgeon, Baynton, began a method of strapping with adhesive plaster and bandaging, by which the disability was completely mastered. We are just re-discovering this.

The surgeon, who may have been Imhotep, nearly five thousand years ago used splints, not only of wood, but of plastered or glued linen; that has a modern sound. He padded wounds after suture with fresh flesh—no doubt to stop hæmorrhage—a method we re-learned in the Great War, and I venture to say the use of which as a hæmostatic is known now to but a small proportion of our profession. He also treated a fractured clavicle by the most refined modern method of placing the patient on his back with a pad between the shoulders. As to wound treatment, the basis of all war surgery, the Greeks in the time of Hippocrates practised unknowingly much asepsis, boiling or filtering the water used to wash wounds, while the surgeon's hands and nails were kept clean and wine was used on wounds as well as poultices around, but not on, the wounds.

Prior to the sacking of Byzantium by the Saracens in 640, surgery as known to the Greeks and Romans was based on scientific reasoning. Thereafter it lapsed badly, and fatalism and magic replaced science for two hundred years, although the writings of the Greeks and Romans had been kept, until the renaissance of surgery in southern Italy, where the tradition of Greek medicine had not been entirely lost.

As late as the thirteenth century, however, when wounds were caused by arrow, sword, lance or dagger, treatment was in the nature of applications of salves, ointments, powders and decoctions, while suppuration was considered normal and necessary for proper healing; if there was none, medicaments were used to promote it in accordance with the teaching of Galen. The wars of this period produced a remarkable set of surgeons. Theodorice, an Italian, denied the "laudable pus" theory and returned to

dressings soaked in wine. William Salicet, another Italian, sewed up wounded large intestine "as furriers sew a skin," replacing it in the abdomen, and found that it healed. De Mondeville, the pupil, went further; he removed foreign bodies from the chest, closing the wound at once. De Chauliac in the next century returned to ointments and middle-some surgery as by the injection of medicaments and the practice in the case of chest wounds of leaving them open; he threw wound treatment back, never to recover completely till the time of Lister, although Paracelsus, another Army surgeon, at the beginning of the sixteenth century was an aseptic.

With the discovery of gunpowder at the end of the thirteenth century wounds became much more unpleasant, and the inflammation that usually resulted was put down to the effect of the gunpowder. The recognized treatment in the hope of preventing it was cauterization with boiling oil. It is a well-known story how Paré, in 1531, running out of oil after his first battle, found to his great relief that the wounds not treated with oil did far better than the others. Hieronymus Brunschweig, in 1497, in the first known article on gunshot wounds, included in a book on war surgery, insisted repeatedly that wounds could not heal without cleanliness. He also held what is perhaps insufficiently realized nowadays, that firearm missiles may sometimes be left in situ without any harm. He had evidently, too, knowledge of human nature, for one of his methods of stopping bleeding was to put the patient in the dark so that he could not see the blood and tell him that it had stopped. Ambroise Paré, in the sixteenth century, was one of the greatest surgeons in history. He is usually credited with the invention of ligation of arteries, but incorrectly, as this procedure appears in the writings of Celsus in the first century A.D., while de Mondeville was also familiar with it. A man of great ability, Paré did more in the actual practice of surgery and in discarding the unpractical therein rather than in adding to it. In his time physicians were not allowed by the church to shed blood, consequently surgeons were looked on as of an inferior caste and formed an unorganized trade. By his efforts their standing was improved before his death. It would appear that he recognized flies as carriers of infectious diseases, and no one prior to him seems to have done so.

It is rather striking that in an age when such preponderating faith was placed in particular remedies, Paré should have realized what even now is so often forgotten, namely, that there are few diseases in which the physician brings about cure; he merely assists the natural processes of repair and resistance. This he showed by his oft-repeated conclusion to a case: "I dressed him and God healed him."

John Hunter, at the beginning of his career, was an Army surgeon, and in the Belleisle expedition, observing carefully the changes appearing in wounds, evolved many of his impressions regarding inflammation. In 1791, nearly thirty years later, he was selected from the ranks of the civil

profession, as was the custom at that time, to be Surgeon-General and Inspector of Hospitals, and died as a result of a disagreement with one of his colleagues. Apart from him no one appears, after Paré, to have achieved very much until the appearance of Larrey, Napoleon's surgeon, often spoken of as the greatest military surgeon that ever lived. Not only did he make great improvements in the medical service of the French Army—such as the establishment of what corresponds to the modern forward operating centre—but his surgical judgment and acumen were so great as to put him far ahead of his times. Indeed, when one reads of his principles and methods one cannot help feeling that he was little behind the best of present-day practice with all its additional knowledge. He excised wounds, removed foreign bodies, ligated arteries, aspirated and sealed chest wounds, used the skin of a newly flayed sheep for the same reason as we now use a hot-air bed in shock, avoided strong antiseptics in wounds unless they were sloughing, knew the value of good food and rest in the prevention of fatigue, knew the principle of rest in inflammation, of drainage, trephined for just the same head injuries as we do now (including post-traumatic disabilities), and operated on empyemata. In addition, his surgical technique must have been something to marvel at; at the Battle of Borodino he is credited with 200 amputations in twenty-four hours. He was the first to perform a disarticulation at the hip-joint, which Guthrie copied later at Waterloo. He has truly been called a benefactor of the human race.

In the same period of history many other Army surgeons of different nations evolved methods of enduring value and made discoveries, such as Dupuytren, Nélaton, Langenbeck, von Graefe, who was Surgeon-General in the German War of Independence and the founder of modern plastic surgery, and Pirogoff, the greatest Russian surgeon and one of the greatest war surgeons of all time, who introduced female nursing to the Army in the field in the Crimea. All of them are known to surgeons the world over as a result of their contributions to surgery. It appears to be no more than a coincidence that in the Crimea also Florence Nightingale on the English side did so much in the provision of trained female nurses in the base hospitals, following this up by establishing the modern system of trained nursing under which nursing became a profession instead of a calling. She did not, however, initiate female nursing in armies; this apparently lies to the credit of the Knights of Saint John, of Saint Lazarus and the Teutonic Knights who enlisted the services of women in their hospitals during the Crusades.

Since the Crimean War supermen in the field of war surgery and medicine have been few. Yet in the American Civil War the occurrence of "soldier's heart" was noted by Da Costa as due to such strains as may occur in civil life. The Franco-Prussian War might have supplied a testing field for Lister's theories of antisepsis and asepsis, so recently put forward, but his methods were then so complex that very little attempt

was made to try them. The South African War provided the incentive to find some means of reducing the crippling wastage from enteric fever. On the other hand, the relatively non-lethal rifle bullet then in use and the infrequency of shell wounds somewhat delayed the progress of treatment of wounds, leading to the adoption of a conservative plan of treatment. The Russo-Japanese War provided the opportunity for the Japanese to show the world that with strict rules and methods of hygiene deaths from sickness could be kept lower than those from battle, an example of some influence in health organization in civil communities and successfully followed by the British in the Great War of 1914-18, to which we now come, and in which deaths from sickness were less than those from wounds in all campaigns except those in Macedonia and Italy.

In the Great War it may be said that, while it was marked by no great discovery of principle in medicine, the benefit to mankind in many directions was enormous. Perhaps the greatest results followed the unprecedented opportunity of mass investigation of the value of methods up to that time improperly understood, under conditions controlled and ideal for observation—in other words, the greatest human vivisection experiments in history. The outstanding example of this was the preventive inoculation against typhoid and paratyphoid fevers. As a result these infections, which have been such scourges in past wars, notably in the Spanish-American War where 20 per cent of the troops were affected and 1.5 per cent died, and the South African War with only slightly lower proportions, in which 55,000 cases occurred and over 8,000 soldiers died, as well as in others too early for any statistical records, were almost abolished. In France in 1918 the morbidity was only 1 in 5,000, and the death-rate 1 in 100,000. In the worst and most uncontrollable theatre of war, Gallipoli, the incidence-rate was 8 per cent and the death-rate under 0.3 per cent.

No such convincing proof of the value of a method applicable to a disease always prevalent in some parts of the world could be obtained apart from war conditions.

The same applies to the prevention of tetanus, for, though it was carried out before the War to a limited extent, the tremendous lesson learned therefrom has resulted in its widespread use in the injuries known as likely to be followed by tetanus, a variety becoming increasingly common with the havoc caused by motor transport.

Not only did the War give the opportunity to explore such methods, but it caused the universal dissemination of their value through the vast army of doctors that was brought in contact with them. For it is a long journey from the discovery of a useful method to its recognition under normal conditions by the medical profession as a whole. And not only were new discoveries broadcast to the profession, but war service acted as a great post-graduate training in many subjects and methods of which much of the profession had insufficient knowledge. One of such was orthopaedics, a branch which many avoid, with the result that patients do

not receive all the treatment that they might. It is largely to this that we owe the popularity of bone-setters and osteopaths, with the resultant development, in defence, of manipulative surgeons. A great deal was learned and taught regarding the repair of injuries to the limbs, treatment of nerve paralysis, artificial limbs and the like. The advantage of segregation of particular injuries and diseases in special wards or hospitals, such as fractures, chest and head wounds, meningitis, functional cardiac disorders and empyema was very manifest. The special fracture, heart, diabetic, rheumatic, tuberculosis and other clinics that are becoming such a feature, and a commendable feature, of modern medicine, owe their origin in no small degree to the example of this specialism of the War. Teamwork, too, which we all recognize as productive of the best results, arises from the experience of the resuscitation, operating and various medical teams of the War. Another gain to the profession was the inculcation of order and method derived from the discipline necessary in the Army machine. Though in this, as in all other wars, there were many more cases of sickness than of wounds, it was in the field of surgery rather than of medicine that the most striking advances were made; and it is somewhat singular that, though a tardy recognition was accorded by the more enlightened in previous wars to the value of medical science in the prevention and treatment of disease, it is only in this last Great War that combatant personnel have come to a recognition of the value of good and prompt surgery in saving life and preventing wastage. There is practically no branch of surgery which has not directly or indirectly felt the benefit of war surgery. Consider what we know practically regarding the prevention of shock that we did not know before. Warmth, rest and tranquillity of mind before operation. And the treatment of shock and loss of blood. Nothing fundamentally new, but the wide knowledge of the wonderful life-saving value of heat, morphine, and above all, blood transfusion. Blood transfusion, instead of being confined to a few and a source of wonder to the laity, is now practised by the many whenever there is the slightest call for it. Certainly the technique has been much simplified since the War, but undoubtedly numberless lives have been saved through the post-war dissemination of the knowledge of blood transfusion, both before, during and after operation, and in haemorrhage, the anemias and as a general stimulant in exhausting and septic diseases.

There was a vast difference in the methods and results of treating wounds at the beginning and at the end of the War, and the knowledge gained is well applicable to civil surgery. At the outset a free use of antiseptics in the wound, as well as around it, was the approved method, and it was not long before the harmfulness of this treatment was recognized, as Hamilton Russell knew and taught before the War, and, as has been mentioned, did Larrey. Several other methods followed this, some of which persist, but the principle of aseptic rather than antiseptic treatment of wounds combined with early removal of foreign bodies and destroyed tissues

which is included under the term excision of wounds, warmth and unavoidable fatigue have brought us to the high-watermark of treatment of war wounds up to the present. And when we think of war wounds, we must picture not a simple cut, but a bruised, mangled, lacerated, dirt-ingrained, blood-starved welter, often associated with splintered bone.

Excision of wounds, which brought about such an entire change in the incidence of sepsis, and particularly of gas gangrene after wounds, and which saved countless lives, is one of the greatest legacies. It is not generally known that the originator of this method, though practised by Larrey and lost sight of, was a Melbourne graduate, E. T. C. Milligan. This procedure has a wide application in the civil surgery of injuries, and is now in everyday use.

Almost everything that is known of that dreadful disease, gas gangrene, was learnt in the Great War. Though it undoubtedly was the cause of great mortality in wars of the past where we read so often of "hospital gangrene," and of one instance in particular related by Paré when at the siege of Metz in mid-winter of 1552 practically all the wounded died, in civil life it was looked on as a rare disease of uncertain aetiology. We see more cases nowadays following industrial and motor accidents, and are in a better position to treat it, knowing that it is most prone to appear in damaged muscle tissue, especially where the blood supply is interfered with, and that it is mostly confined to single muscles or groups of muscles and must be treated by excision of the affected muscles. The anti-serum prepared late in the War for the specific organisms is in some cases very efficient; since the War it has been used with success in other conditions such as intestinal obstruction and peritonitis. There is some evidence that the serum may be valuable prophylactically, and a possibility that an anatoxin may be used to produce artificial immunity.

An early and valuable sign of the development of gas gangrene was recognized in the rapid and otherwise inexplicable increase of pain in the wound, accompanied by marked swelling.

In the field of chest surgery the use of X-rays was developed to recognize the amount of fluid and collapse of lung, the value of aspiration in hæmothorax became known, and the necessity for closing sucking wounds, while surgeons have become familiar with the manipulation of thoracic organs inside the open chest. Prior to the War this was a *noli me tangere* area, except with complicated apparatus like the Sauerbruch and other pressure cabinets. We learned the readiness with which the wounded heart can be repaired and intracardiac foreign bodies removed. From the huge streptococcal post-influenza empyema epidemic in the American camps we gained a knowledge of the fatality of early thoracotomy in such cases and the limited application of the principle of repeated aspiration prior to rib resection in the commoner pneumococcal empyema; and also of the danger of too open drainage.

In the field of brain surgery advances were mostly in technique such as

local anaesthesia and the control of haemorrhage by the "postage stamp" muscle application. But the principles were established of thoroughness of cleaning up, the necessity of removal of foreign bodies, drainage and post-operative rest. We recognized that the brain has definite powers of resistance to and recovery from infection, and it was the same in regard to the pleura and synovial membranes. A great deal also was learned regarding cerebral localization. In joints, the advisability of closure and the harm of drainage tubes were established, but this now seems to have been to a certain extent forgotten. The improvement in the treatment of fractures, remarkable as it was, was particularly notable in regard to the femur, the cause of high mortality in the early days of the War, where the Thomas splint replaced the unhappy Liston, and the efforts of Sinclair and Pearson showed what improvement in results could be brought about by specialization, thoroughness and team-work. Should the specialized application of pre-existing methods advocated by Böhler prove to be permanently acceptable to surgeons as an advance in treatment, this may be credited to war, for Böhler was a war surgeon impelled by the bad results in fractures as commonly treated to try for something better.

A tremendous amount was learned about the possibilities of plastic surgery of the face, and wonderful results achieved that were unheard of before the War. The application of this in civil surgery, though somewhat limited, is of definite value, and we owe it largely to Gillies, and others. The use of sliding muscle flaps, as practised in wounds of the chest and abdomen, must also be mentioned. Amongst minor gains is the application of maggots in acute osteomyelitis, the result of observation by an American surgeon, Baer, of the results in compound fractures of femora which became infested with maggots. It may be noted that Larrey was aware of this.

As regards venereal disease, no new methods arose, but much was learned from mass observation. Prevention of gonorrhoea was first attempted on a large scale and established; this was far from a new method, for Salicet practised it in the thirteenth century. Prophylaxis of syphilis was found to be simple and successful, and the necessity for repeated courses of treatment and careful following up over a long period became more definitely understood. The Navy was responsible for much of this. The conclusion emerged from the large quantity of cases that present methods of treatment are very satisfactory.

When we turn to pure medicine, we do not find so many advances to signalize. Certainly a new disease, trench fever, was recognized and its cause discovered, but this seems to have no civil application. Trench nephritis, previously recognized in the American Civil War, gave an opportunity for observing acute nephritis in the mass, with the result that we know more of its prognosis, course and classification and the distinction from chronic degenerative and arteriosclerotic nephritis. Trench feet comes under the same category, a troublesome condition also referred to by Larrey. From the study of functional heart disabilities a great deal was learned, and again, not for the first time in war; and a large education

was given to the profession in the distinction between functional and organic lesions and the vast difference in prognosis.

In psychiatry an unheard-of field of observation presented, and it was found that the War brought about little increase in true psychosis or insanity, though an enormous number of cases of psychoneurosis were treated, showing that even in war the psychic element is the dominant factor; for example, shell-shock.

We may claim the production of Haldane's oxygen apparatus and its modifications applicable to pneumonias and other lung conditions, carbon monoxide poisoning and heart failure, as due to the necessity of treatment of poison gassing.

The discovery of the cause of bilharziosis, so terribly prevalent in Egypt, by Leiper, and its curative treatment by Christopherson, both Army medical officers, were of far-reaching importance. Though bilharziosis has not become endemic in Australia, we may consider it good fortune that it has not, as all the necessary factors for its establishment were present after the War.

Much was learned of the treatment of the dysenteries, of bacillary dysentery by the sulphates and antiserum, and of amoebic dysentery by emetine, as well as a great deal about the microscopic diagnosis in both.

Malaria was the greatest single cause of sick wastage, and something was learned of details of treatment and still more of the methods of prevention of mosquito breeding.

Practically all we know of encephalitis lethargica has been discovered during and since the War. Though it has probably occurred before, in England perhaps in 1685, it was not recognized until 1917. It is one of a group of diseases to which cerebrospinal fever and poliomyelitis belong, in which the pathological agent is frequently present in the human being without causing an attack of the disease until the balance between the virulence of the virus and the immunity of the individual goes in favour of the virus. It is probable, too, that as was found in the case of cerebrospinal fever, an epidemic does not occur until the carriers reach a definite percentage—in the case of cerebrospinal fever about 20 per cent. A far more common and important condition is avitaminosis, and we are indebted to the Great War for a great deal of our present knowledge of its effects and treatment, even if unhappily much of it has come from study of the effects of starvation of children in beaten countries and of prisoners of war.

In anaesthetics the use of local injections was popularized, and the unfavourable after-effects of long ether anaesthetics were recognized as well as the important advantages of nitrous oxide, already well known in the United States, but very little in Great Britain and Australia.

Apart from a chronological survey of the benefits arising from war, it is well recognized what a difference has been made to life in the tropics by the efforts of Army surgeons. Most of the insect vector discoveries are a result of military organization, and the methods of avoidance of tropical

diseases are due to military hygienists. Malaria, one of the greatest causes of illness and death in modern history, a determining factor in the history of the world, the cause—partial at least—of the decay of Greece and Rome owing to the slow but steady infection with the malignant tertian variety, the cause of the disappearance of the Moghul empire and the kingdom of Ceylon and the winner of many wars, was found by Laveran to be caused by a plasmodium. In 1897 Ross, labouring in the face of official opposition, discovered its transference to man by the anopheles mosquito, and opened the way to its prevention, while the Spanish conquests in South America had in the time of Ferdinand and Isabella brought quinine back to Europe.

Yellow fever, for centuries the cause of fearful mortality in the Americas, was found by Major Reed to be due to the *Stegomyia* mosquito. Gorgas, who later made the Panama Canal possible by his fight with malaria, in eight months in 1901 freed Cuba of yellow fever by attacking the *Stegomyia* and isolating fresh cases, and this successful eradication started by Army surgeons has been widely and successfully adopted for both yellow fever and malaria.

Rogers, another Army surgeon, was responsible for the valuable hypertonic treatment of cholera which has saved many lives, a method applicable to the heat cramps occurring in hot mines when water is drunk too freely, and to the loss of chlorides in intestinal obstruction.

One of the great health problems of life in the tropics has always been the effects of high solar temperature which manifest themselves in different forms commonly known as heat exhaustion, heat stroke and sunstroke. There has always been a great deal of confusion as to the exact meaning of these terms. An excellent opportunity of controlled investigation in the mass presented itself in Mesopotamia, and, while it cannot be said that finality has been reached, a great deal has been learned on the subject and a number of empiric beliefs have been demolished. Of still more importance has been the recognition of certain premonitory symptoms of heat stroke which, if followed promptly by the methods of treatment there worked out, has brought about the position that fatal results can almost always be avoided. With this let me bring the account of the benefits of war to a close, though the field has been skimmed.

Enough has been said, I think, to establish my thesis that medical science and practice have had through the ages much for which to be grateful to war. Let us hope for an era when progress may be equally rapid without the evils of war.

If now we turn to the other side of the picture and ponder on the benefits of medical progress to war, we are brought up by the wonderful amount of knowledge now available to a commander in the field to keep his army intact as compared with the general of all past ages. As many wars and battles, if not more, have been decided by disease than by force of arms. Let us mention some of the most striking out of the many. Sennacherib, the Assyrian, in the eighth century B.C., with his host was

struck by the "Angel of the Lord" so that in a night he lost 150,000 men and was forced to depart. Probably this was some epidemic. When Xerxes was marching on Greece with an army of 800,000, the Greeks were saved by an epidemic—perhaps plague and dysentery—which attacked him and which forced him to return to Persia, without fighting, with less than half a million men.

The Crusades furnish perhaps the most dramatic known instances of disease. The first, in 1098, gives us a force of 300,000 besieging Antioch and then Jerusalem, reduced in two years to some 20,000 almost entirely by disease. Of half a million who set out on the second Crusade, disease accounted for all but a handful, if any, who returned to Europe. Plague, and not the Saracens, prevented the fourth Crusade from reaching Jerusalem. In more recent times the French in Haiti lost 22,000 out of 25,000 men, enough to allow the negroes to turn them out of the island, while the English at Cartagena, in one of the hopelessly mismanaged expeditions that distinguished our military history of the eighteenth century, lost nine out of every ten men that set out. The failure of the Walcheren expedition from malaria is perhaps the best-known example of this kind in English history.

In these and other examples of disease-won campaigns it is not always possible to identify the epidemic, but the chief killers we recognize have been plague, smallpox, typhoid, typhus, malaria, dysentery and possibly influenza. Of plague, which in the fourteenth century destroyed perhaps twenty-five million people in Europe, we now know the cause and how to prevent, if not to cure it. Smallpox we can more actively and easily control, given the time and material. Dysentery, too, with much trouble can be checked, but influenza, whether of recent or ancient origin, is beyond our powers both of prevention and treatment, and this alone of all great epidemic diseases caused more loss of human life in the great world epidemic of 1918 than did battle casualties in the Great War. The control of typhoid and malaria I have laid claim to as largely a result of war.

In the view of many typhus fever has been the greatest killer in history. It has decided wars, ended them without decision, and prevented wars, yet war did nothing to rid mankind of this scourge. Not until 1909 was it demonstrated by Nicolle that the louse was the carrier of typhus, the knowledge that the virus lay in the Rickettsia bodies and that in some circumstances the rat flea could act as host for the virus following in the ensuing years. It appears most probable that typhus fever came from the East to Europe. When it first made its appearance is conjectural; with the lack of medical knowledge of the early middle ages this is not surprising, for the disease does not display particularly distinguishing characteristics. Even in present times it remains undiagnosed. In 1898 a disease known as Brill's disease appeared in the north-east of the United States of America and continued for twenty-eight years before it was recognized as typhus by a doctor who was familiar with its manifestations

in Europe. Then, too, in early times the descriptions of epidemics of obviously more than one disease make their recognition nearly impossible. It has been thought by some that the Athenian fever of the Peloponnesian War was typhus, but this cannot be regarded as proven. The first description of an epidemic which can reasonably be recognized as typhus was in 1083 in Italy, and it is not again in evidence till the end of the fifteenth century. Its first known great political effect was in 1528, when it caused the abandonment of the siege of Naples by the French and brought the Papal State under the dominant influence of Spain and thus altered the subsequent history of Europe. From that time onwards we find it a companion of the constant wars that ravaged Europe for the ensuing centuries, playing a greater part than the arms of the combatants in slaying friend and foe, frequently deciding the issues between the warring States and decimating the unfortunate civilians.

It is a remarkable and largely unexplainable phenomenon that in the last and greatest of wars, with the exception of the outbreak in Serbia in the early months which so checked the Austrians in their invasion, the disease was practically non-existent in the millions fighting in Western Europe. The louse was as constant as in other wars, and the cause of other diseases, but for some unknown reason typhus did not appear in circumstances so favourable for its spread.

Had it done so, the discoveries of medicine had placed in the hands of the Armies the knowledge to control the ravages of the disease so apparent in the past, even if not yet to cure it. Perhaps a cure may result from other wars.

But apart from disease medical knowledge has done much to prevent that all-important loss of man-power by teaching what is necessary in the constitution and amount of the soldier's food ration if he is to maintain his strength and resistance to fatigue, loss of morale, and disease. Scurvy has been banished, the voyages of Captain Cook being not without influence in this achievement, and beri-beri and pellagra, which became almost universal in the Turkish Army in Syria in 1918, can be avoided. None the less proper clothing, amusement, rest and cover from the elements such as of old were deemed necessary for his steed or hound and not for his men, are now by experience and precept as great a necessity for a true commander as are training and munitions. For this, medicine must take some credit. And, last of all, prevention of sepsis in wounds, however perfect by empiric knowledge, could never have persisted had not its true cause been patiently and certainly unveiled.

Perhaps some day we may traverse the path of learning still further and find what manner of disease it is that causes man to go to war on man.

ACKNOWLEDGMENTS.

My thanks must be expressed to many of my professional brethren who have discussed this subject with me and helped me greatly with suggestions and references to literature.

WHAT MEDICINE OWES TO WAR
AND WAR OWES TO MEDICINE.

By Major-General R. M. Downes, C.M.G., V.D.,
D.G.M.S., Australian Military Forces.

Reprinted from the Journal of the Royal Army Medical Corps,
December, 1936.



LONDON: JOHN BALE,
SONS & DANIELSSON,
Ltd., OXFORD HOUSE,
83-91, GT. TITCHFIELD
STREET, W.1.

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By MAJOR-GENERAL R. M. DOWNES, C.M.G., V.D.,
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PRESIDENTIAL addresses in this Branch have sometimes covered professional subjects of especial interest to the speaker, sometimes matters of import to the organization, economics or standing of the profession, sometimes a review of the happenings and tendencies of his year of office, and occasionally matters of history. It might have been thought that in such an epochal year of our Branch history a survey of what the recent annual meeting of the Association has meant to us and will do for us would be the most appropriate theme; but I felt that a little more time would make the repercussions more definite, and, furthermore, that perhaps we have earned a slight respite from medical politics. So I thought the more readily to interest the stout few who always form the audience at these annual occasions by some story concerning the subject that now is my chief interest—the Medical Services of the Army and Air Force—and in the brief period that has been available to find such a story in this year of grace, I decided that it might be profitable to review the influence of war and medicine on each other.

As Sherman, and no doubt millions of others, said: "War is hell"; nevertheless it is a biological necessity that has to be faced, and the history of the human race is largely written in war. What knowledge did our craft forefathers and what do we, the descendants of *Esculapius*, owe to war, and what has the same army of healers done to make the waging of war more possible?

First of all we should from its earliest known beginnings trace as carefully as possible the evolution of the great complicated machine which now serves the health of soldiers in the field, but time will not permit of doing this in detail. Let us, however, take notice of the growth of this machine from a feeble thing of few parts in which the personality, intellect and character of the individual was the dominant factor, to the complicated organization of mutually dependent workers that with much oiling by experience has become the more or less smoothly running engine—a modern army medical service. In the past names such as Theodoric, Paré, Larrey and McGrigor stand out in their periods as men to be wondered at; yet the lot of their sick and wounded could not be compared

¹ An address read at the Annual Meeting of the Victorian Branch of the British Medical Association on December 4, 1935. This article has appeared in the *Medical Journal of Australia* and is published here by permission of the editor of that Journal.

with that of their successors in the last Great War. The individuals responsible for this improvement, however, are so many and of such equal achievement that no single man could win that fame that permits his name to go down among the great in history.

As long as mankind has existed there has certainly been war; war means wounds and wounds mean people to treat them. The earliest evidence of treatment, going back almost to the first known writing in history, is found in one of the most fascinating and delightful documents any student of history could hope for, the Edwin Smith papyrus. Named after its discoverer, who obtained it at Luxor in Upper Egypt in 1862, it lay undeciphered until 1928, when it was published.¹ It is a copy by an unknown physician of the eighteenth dynasty in the seventeenth century B.C. of the surgical treatise of the Pyramid Age, written at least one thousand years earlier. There is some reason to conjecture that the author may have been the first known physician, Imhotep, a great personality of the third dynasty, about 3000 B.C., who after his death was deified and worshipped by the Greeks as Asklepios, by the Romans as Esculapius, the God of Healing. He was high priest, vizier, architect and philosopher to the great King Zoser of that dynasty. From his description of cases, it is obvious that he followed the wars. His methods of treatment were founded on observation and thought, and are in sharp contrast to those of his unknown copyist of some 1,800 years later, whose principles of treatment appearing in the same document depend on incantations, charms, magic and weird medicaments. All of the fifty-eight cases described are dealt with in most orderly fashion—first the title, then the examination, followed by the diagnosis, treatment, and in some cases, a glossary of the meaning of terms that had gone out of use in the intervening years. The wounds and injuries are described in order from the head downwards, while in the different areas superficial and slight wounds precede those penetrating more deeply. It is interesting to note that surgical operations were considered only as part of the examination, nothing that did not include application of medicaments being dignified as treatment. In all cases a decision as to its possible cure is given in one of the formulae "an ailment that I will treat," "an ailment with which I will contend," or "an ailment not to be treated." Imhotep knew something of cerebral localization to the opposite side of the brain, of the spine as a nervous centre, of the existence of a cardiac system and the pulse, and was very close to a knowledge of the circulation of the blood. He dissected, made use of his finger as a probe, describes what can be recognized as tetanus, and depended on Nature considerably for cure. Some of the methods, which make us wonder whether anything is new, will be mentioned as we go along.

We next learn of what corresponds to our present-day regimental

¹ It is a sad coincidence that we read in the cablegrams of the death of the translator, the famous Egyptologist, Breasted.

medical officers in the Trojan War, about 1200 B.C. Again Hippocrates in the fifth century B.C. alludes to them several times, one being his son, Thessalus. The Romans, however, until much later, made no use of physicians in their armies, apart from those whom the commanders or other officers took into the field for their private use. Pliny says that they were none the worse off for the lack. It appears that about the first century B.C. they established a regular medical service consisting of both physicians and tents for the sick, the latter forming hospitals or *valedudinaria*, the ruins of one of which are found in a camp of the first century A.D. The first record of the forerunner of the modern field ambulance is in the Roman Army in the sixth century; after that they seem to have gone out of fashion for some centuries. While Henry of Navarre at the end of the sixteenth century established "portable hospitals" in addition to "fixed hospitals," the former being christened "ambulances," they do not appear in British history till the wars of William III and Mary, when they were called "marching and flying hospitals" and included springed ambulance wagons. They disappeared, however, after Marlborough's campaigns which ended in 1711 until the nineteenth century, when McGrigor persuaded Wellington, in the Peninsula War, to allow him to form regimental in addition to base hospitals. Napoleon's great surgeon, Larrey, had, however, reintroduced "flying ambulances" a few years earlier. His ambulance cadre, or division comprising a personnel of 340 and including 12 light and 4 heavy cars, was ahead of anything of the kind in any war, even including the South African, up to the Great War. In these the wounded after Eylau in 1807 were transported to châteaux more than fifty-five leagues distant. There was little advance in the English Army in the Crimea, nor till the South African War, when "bearer companies" and "field hospitals" came into being. The next step was in their amalgamation after this war into field ambulances, which have undergone considerable modification and additions both during and since the Great War (be it noted that a similar name was given a century earlier to the Napoleonic Wars) into units which provide for operative and medical treatment, as well as wheeled motor transport for the sick and wounded from the battlefield. The former fixed hospitals are now known as general hospitals, while an intermediate casualty clearing station has been introduced and convalescent depôts for the healed. The springless carts for the wounded have grown into motor ambulance convoys, hospital trains, hospital barges, hospital ships and aeroplane ambulances. These, with units for bacteriological and chemical examination, for the supply of every variety of medical and surgical equipment and the manufacture of splints, make up the modern army medical service.

Contrast the few lone physicians of earliest history with the mobilization, almost complete, of the whole medical profession of Great Britain, Germany and France, and the hundreds of thousands of rank and file of the last war.

My purpose is to review whatever knowledge in the art of healing and in prevention of disease has come from the long pageant of Army physicians. Since soldiers in the main are the pick of the community, young and healthy, and through their calling prone to injuries, it is natural that surgery is the branch of medicine that has most benefited, and traumatic surgery in particular. In fact nearly all early surgery was war surgery, and very little advance was made apart from war. In England at least, training in surgery was obtainable only in war until the middle of the eighteenth century, when civil hospitals became numerous. The charter of the Royal College of Surgeons of Ireland includes "for the purpose of training surgeons for His Majesty's Army."

It is not possible in this paper to survey in any detail the progress of military surgery, but it is noticeable how periods of enlightenment were followed by those of ignorance, and how often discoveries are rediscovered. One may cite Larrey, who practised excision of wounds, a practice now looked on as probably the greatest surgical advance of the last war. Then at the beginning of the nineteenth century ulcers of the leg were a great cause of invalidism in the Army till an Army surgeon, Baynton, began a method of strapping with adhesive plaster and bandaging, by which the disability was completely mastered. We are just re-discovering this.

The surgeon, who may have been Imhotep, nearly five thousand years ago used splints, not only of wood, but of plastered or glued linen; that has a modern sound. He padded wounds after suture with fresh flesh—no doubt to stop hæmorrhage—a method we re-learned in the Great War, and I venture to say the use of which as a hæmostatic is known now to but a small proportion of our profession. He also treated a fractured clavicle by the most refined modern method of placing the patient on his back with a pad between the shoulders. As to wound treatment, the basis of all war surgery, the Greeks in the time of Hippocrates practised unknowingly much asepsis, boiling or filtering the water used to wash wounds, while the surgeon's hands and nails were kept clean and wine was used on wounds as well as poultices around, but not on, the wounds.

Prior to the sacking of Byzantium by the Saracens in 640, surgery as known to the Greeks and Romans was based on scientific reasoning. Thereafter it lapsed badly, and fatalism and magic replaced science for two hundred years, although the writings of the Greeks and Romans had been kept, until the renaissance of surgery in southern Italy, where the tradition of Greek medicine had not been entirely lost.

As late as the thirteenth century, however, when wounds were caused by arrow, sword, lance or dagger, treatment was in the nature of applications of salves, ointments, powders and decoctions, while suppuration was considered normal and necessary for proper healing; if there was none, medicaments were used to promote it in accordance with the teaching of Galen. The wars of this period produced a remarkable set of surgeons. Theodoric, an Italian, denied the "laudable pus" theory and returned to

dressings soaked in wine. William Salicet, another Italian, sewed up wounded large intestine "as furriers sew a skin," replacing it in the abdomen, and found that it healed. De Mondeville, the pupil, went further: he removed foreign bodies from the chest, closing the wound at once. De Chauliac in the next century returned to ointments and meddlesome surgery as by the injection of medicaments and the practice in the case of chest wounds of leaving them open; he threw wound treatment back, never to recover completely till the time of Lister, although Paracelsus, another Army surgeon, at the beginning of the sixteenth century was an asepticist.

With the discovery of gunpowder at the end of the thirteenth century wounds became much more unpleasant, and the inflammation that usually resulted was put down to the effect of the gunpowder. The recognized treatment in the hope of preventing it was cauterization with boiling oil. It is a well-known story how Paré, in 1531, running out of oil after his first battle, found to his great relief that the wounds not treated with oil did far better than the others. Hieronymus Braunschweig, in 1497, in the first known article on gunshot wounds, included in a book on war surgery, insisted repeatedly that wounds could not heal without cleanliness. He also held what is perhaps insufficiently realized nowadays, that firearm missiles may sometimes be left in situ without any harm. He had evidently, too, knowledge of human nature, for one of his methods of stopping bleeding was to put the patient in the dark so that he could not see the blood and tell him that it had stopped. Ambroise Paré, in the sixteenth century, was one of the greatest surgeons in history. He is usually credited with the invention of ligature of arteries, but incorrectly, as this procedure appears in the writings of Celsus in the first century A.D., while de Mondeville was also familiar with it. A man of great ability, Paré did more in the actual practice of surgery and in discarding the unpractical therein rather than in adding to it. In his time physicians were not allowed by the church to shed blood, consequently surgeons were looked on as of an inferior caste and formed an unorganized trade. By his efforts their standing was improved before his death. It would appear that he recognized flies as carriers of infectious diseases, and no one prior to him seems to have done so.

It is rather striking that in an age when such preponderating faith was placed in particular remedies, Paré should have realized what even now is so often forgotten, namely, that there are few diseases in which the physician brings about cure; he merely assists the natural processes of repair and resistance. "This he showed by his oft-repeated conclusion to a case: "I dressed him and God healed him."

John Hunter, at the beginning of his career, was an Army surgeon, and in the Belleisle expedition, observing carefully the changes appearing in wounds, evolved many of his impressions regarding inflammation. In 1791, nearly thirty years later, he was selected from the ranks of the civil

profession, as was the custom at that time, to be Surgeon-General and Inspector of Hospitals, and died as a result of a disagreement with one of his colleagues. Apart from him no one appears, after Paré, to have achieved very much until the appearance of Larrey, Napoleon's surgeon, often spoken of as the greatest military surgeon that ever lived. Not only did he make great improvements in the medical service of the French Army—such as the establishment of what corresponds to the modern forward operating centre—but his surgical judgment and acumen were so great as to put him far ahead of his times. Indeed, when one reads of his principles and methods one cannot help feeling that he was little behind the best of present-day practice with all its additional knowledge. He excised wounds, removed foreign bodies, ligated arteries, aspirated and sealed chest wounds, used the skin of a newly flayed sheep for the same reason as we now use a hot-air bed in shock, avoided strong antiseptics in wounds unless they were sloughing, knew the value of good food and rest in the prevention of fatigue, knew the principle of rest in inflammation, of drainage, trephined for just the same head injuries as we do now (including post-traumatic disabilities), and operated on empyemata. In addition, his surgical technique must have been something to marvel at; at the Battle of Borodino he is credited with 200 amputations in twenty-four hours. He was the first to perform a disarticulation at the hip-joint, which Guthrie copied later at Waterloo. He has truly been called a benefactor of the human race.

In the same period of history many other Army surgeons of different nations evolved methods of enduring value and made discoveries, such as Dupuytren, Nélaton, Langenbeck, von Graefe, who was Surgeon-General in the German War of Independence and the founder of modern plastic surgery, and Pirogoff, the greatest Russian surgeon and one of the greatest war surgeons of all time, who introduced female nursing to the Army in the field in the Crimea. All of them are known to surgeons the world over as a result of their contributions to surgery. It appears to be no more than a coincidence that in the Crimea also Florence Nightingale on the English side did so much in the provision of trained female nurses in the base hospitals, following this up by establishing the modern system of trained nursing under which nursing became a profession instead of a calling. She did not, however, initiate female nursing in armies; this apparently lies to the credit of the Knights of Saint John, of Saint Lazarus and the Teutonic Knights who enlisted the services of women in their hospitals during the Crusades.

Since the Crimean War supermen in the field of war surgery and medicine have been few. Yet in the American Civil War the occurrence of "soldier's heart" was noted by Da Costa as due to such strains as may occur in civil life. The Franco-Prussian War might have supplied a testing field for Lister's theories of antiseptics and asepsis, so recently put forward, but his methods were then so complex that very little attempt

was made to try them. The South African War provided the incentive to find some means of reducing the crippling wastage from enteric fever. On the other hand, the relatively non-lethal rifle bullet then in use and the infrequency of shell wounds somewhat delayed the progress of treatment of wounds, leading to the adoption of a conservative plan of treatment. The Russo-Japanese War provided the opportunity for the Japanese to show the world that with strict rules and methods of hygiene deaths from sickness could be kept lower than those from battle, an example of some influence in health organization in civil communities and successfully followed by the British in the Great War of 1914-18, to which we now come, and in which deaths from sickness were less than those from wounds in all campaigns except those in Macedonia and Italy.

In the Great War it may be said that, while it was marked by no great discovery of principle in medicine, the benefit to mankind in many directions was enormous. Perhaps the greatest results followed the unprecedented opportunity of mass investigation of the value of methods up to that time improperly understood, under conditions controlled and ideal for observation—in other words, the greatest human vivisection experiments in history. The outstanding example of this was the preventive inoculation against typhoid and paratyphoid fevers. As a result these infections, which have been such scourges in past wars, notably in the Spanish-American War where 20 per cent of the troops were affected and 1.5 per cent died, and the South African War with only slightly lower proportions, in which 55,000 cases occurred and over 8,000 soldiers died, as well as in others too early for any statistical records, were almost abolished. In France in 1918 the morbidity was only 1 in 5,000, and the death-rate 1 in 100,000. In the worst and most uncontrollable theatre of war, Gallipoli, the incidence-rate was 8 per cent and the death-rate under 0.3 per cent.

No such convincing proof of the value of a method applicable to a disease always prevalent in some parts of the world could be obtained apart from war conditions.

The same applies to the prevention of tetanus, for, though it was carried out before the War to a limited extent, the tremendous lesson learned therefrom has resulted in its widespread use in the injuries known as likely to be followed by tetanus, a variety becoming increasingly common with the havoc caused by motor transport.

Not only did the War give the opportunity to explore such methods, but it caused the universal dissemination of their value through the vast army of doctors that was brought in contact with them. For it is a long journey from the discovery of a useful method to its recognition under normal conditions by the medical profession as a whole. And not only were new discoveries broadcast to the profession, but war service acted as a great post-graduate training in many subjects and methods of which much of the profession had insufficient knowledge. One of such was orthopaedics, a branch which many avoid, with the result that patients do

not receive all the treatment that they might. It is largely to this that we owe the popularity of bone-setters and osteopaths, with the resultant development, in defence, of manipulative surgeons. A great deal was learned and taught regarding the repair of injuries to the limbs, treatment of nerve paralysis, artificial limbs and the like. The advantage of segregation of particular injuries and diseases in special wards or hospitals, such as fractures, chest and head wounds, meningitis, functional cardiac disorders and emphyema was very manifest. The special fracture, heart, diabetic, rheumatic, tuberculosis and other clinics that are becoming such a feature, and a commendable feature, of modern medicine, owe their origin in no small degree to the example of this specialism of the War. Team-work, too, which we all recognize as productive of the best results, arises from the experience of the resuscitation, operating and various medical teams of the War. Another gain to the profession was the inculcation of order and method derived from the discipline necessary in the Army machine. Though in this, as in all other wars, there were many more cases of sickness than of wounds, it was in the field of surgery rather than of medicine that the most striking advances were made; and it is somewhat singular that, though a tardy recognition was accorded by the more enlightened in previous wars to the value of medical science in the prevention and treatment of disease, it is only in this last Great War that combatant personnel have come to a recognition of the value of good and prompt surgery in saving life and preventing wastage. There is practically no branch of surgery which has not directly or indirectly felt the benefit of war surgery. Consider what we know practically regarding the prevention of shock that we did not know before. Warmth, rest and tranquillity of mind before operation. And the treatment of shock and loss of blood. Nothing fundamentally new, but the wide knowledge of the wonderful life-saving value of heat, morphine, and above all, blood transfusion. Blood transfusion, instead of being confined to a few and a source of wonder to the laity, is now practised by the many whenever there is the slightest call for it. Certainly the technique has been much simplified since the War, but undoubtedly numberless lives have been saved through the post-war dissemination of the knowledge of blood transfusion, both before, during and after operation, and in hæmorrhage, the anæmias and as a general stimulant in exhausting and septic diseases.

There was a vast difference in the methods and results of treating wounds at the beginning and at the end of the War, and the knowledge gained is well applicable to civil surgery. At the outset a free use of antiseptics in the wound, as well as around it, was the approved method, and it was not long before the harmfulness of this treatment was recognized, as Hamilton Russell knew and taught before the War, and, as has been mentioned, did Larrey. Several other methods followed this, some of which persist, but the principle of aseptic rather than antiseptic treatment of wounds combined with early removal of foreign bodies and destroyed tissues

which is included under the term excision of wounds, warmth and unavoidable fatigue have brought us to the high-watermark of treatment of war wounds up to the present. And when we think of war wounds, we must picture not a simple cut, but a bruised, mangled, lacerated, dirt-ingrained, blood-starved welter, often associated with splintered bone.

Excision of wounds, which brought about such an entire change in the incidence of sepsis, and particularly of gas gangrene after wounds, and which saved countless lives, is one of the greatest legacies. It is not generally known that the originator of this method, though practised by Larrey and lost sight of, was a Melbourne graduate, E. T. C. Milligan. This procedure has a wide application in the civil surgery of injuries, and is now in everyday use.

Almost everything that is known of that dreadful disease, gas gangrene, was learnt in the Great War. Though it undoubtedly was the cause of great mortality in wars of the past where we read so often of "hospital gangrene," and of one instance in particular related by Paré when at the siege of Metz in mid-winter of 1552 practically all the wounded died, in civil life it was looked on as a rare disease of uncertain aetiology. We see more cases nowadays following industrial and motor accidents, and are in a better position to treat it, knowing that it is most prone to appear in damaged muscle tissue, especially where the blood supply is interfered with, and that it is mostly confined to single muscles or groups of muscles and must be treated by excision of the affected muscles. The anti-serum prepared late in the War for the specific organisms is in some cases very efficient; since the War it has been used with success in other conditions such as intestinal obstruction and peritonitis. There is some evidence that the serum may be valuable prophylactically, and a possibility that an antotoxin may be used to produce artificial immunity.

An early and valuable sign of the development of gas gangrene was recognized in the rapid and otherwise inexplicable increase of pain in the wound, accompanied by marked swelling.

In the field of chest surgery the use of X-rays was developed to recognize the amount of fluid and collapse of lung, the value of aspiration in hemothorax became known, and the necessity for closing sucking wounds, while surgeons have become familiar with the manipulation of thoracic organs inside the open chest. Prior to the War this was a *noli me tangere* area, except with complicated apparatus like the Sauerbruch and other pressure cabinets. We learned the readiness with which the wounded heart can be repaired and intracardiac foreign bodies removed. From the huge streptococcal post-influenza emphyema epidemic in the American camps we gained a knowledge of the fatality of early thoracotomy in such cases and the limited application of the principle of repeated aspiration prior to rib resection in the commoner pneumococcal emphyema; and also of the danger of too open drainage.

In the field of brain surgery advances were mostly in technique such as

local anaesthesia and the control of haemorrhage by the "postage stamp" muscle application. But the principles were established of thoroughness of cleaning up, the necessity of removal of foreign bodies, drainage and post-operative rest. We recognized that the brain has definite powers of resistance to and recovery from infection, and it was the same in regard to the pleura and synovial membranes. A great deal also was learned regarding cerebral localization. In joints, the advisability of closure and the harm of drainage tubes were established, but this now seems to have been to a certain extent forgotten. The improvement in the treatment of fractures, remarkable as it was, was particularly notable in regard to the femur, the cause of high mortality in the early days of the War, where the Thomas splint replaced the unhappy Liston, and the efforts of Sinclair and Pearson showed what improvement in results could be brought about by specialization, thoroughness and team-work. Should the specialized application of pre-existing methods advocated by Böhler prove to be permanently acceptable to surgeons as an advance in treatment, this may be credited to war, for Böhler was a war surgeon impelled by the bad results in fractures as commonly treated to try for something better.

A tremendous amount was learned about the possibilities of plastic surgery of the face, and wonderful results achieved that were unheard of before the War. The application of this in civil surgery, though somewhat limited, is of definite value, and we owe it largely to Gillies, and others. The use of sliding muscle flaps, as practised in wounds of the chest and abdomen, must also be mentioned. Amongst minor gains is the application of maggots in acute osteomyelitis, the result of observation by an American surgeon, Baer, of the results in compound fractures of femora which became infested with maggots. It may be noted that Larrey was aware of this.

As regards venereal disease, no new methods arose, but much was learned from mass observation. Prevention of gonorrhoea was first attempted on a large scale and established; this was far from a new method, for Salicet practised it in the thirteenth century. Prophylaxis of syphilis was shown to be simple and successful, and the necessity for repeated courses of treatment and careful following up over a long period became more definitely understood. The Navy was responsible for much of this. The conclusion emerged from the large quantity of cases that present methods of treatment are very satisfactory.

When we turn to pure medicine, we do not find so many advances to signalize. Certainly a new disease, trench fever, was recognized and its cause discovered, but this seems to have no civil application. Trench nephritis, previously recognized in the American Civil War, gave an opportunity for observing acute nephritis in the mass, with the result that we know more of its prognosis, course and classification and the distinction from chronic degenerative and arteriosclerotic nephritis. Trench feet comes under the same category, a troublesome condition also referred to by Larrey. From the study of functional heart disabilities a great deal was learned, and again, not for the first time in war; and a large education

was given to the profession in the distinction between functional and organic lesions and the vast difference in prognosis.

In psychiatry an unheard-of field of observation presented, and it was found that the War brought about little increase in true psychosis or insanity, though an enormous number of cases of psychoneurosis were treated, showing that even in war the psychic element is the dominant factor; for example, shell-shock.

We may claim the production of Haldane's oxygen apparatus and its modifications applicable to pneumonias and other lung conditions, carbon monoxide poisoning and heart failure, as due to the necessity of treatment of poison gassing.

The discovery of the cause of bilharziosis, so terribly prevalent in Egypt, by Leiper, and its curative treatment by Christopherson, both Army medical officers, were of far-reaching importance. Though bilharziosis has not become endemic in Australia, we may consider it good fortune that it has not, as all the necessary factors for its establishment were present after the War.

Much was learned of the treatment of the dysenteries, of bacillary dysentery by the sulphates and antiserum, and of amoebic dysentery by emetine, as well as a great deal about the microscopic diagnosis in both.

Malaria was the greatest single cause of sick wastage, and something was learned of details of treatment and still more of the methods of prevention of mosquito breeding.

Practically all we know of encephalitis lethargica has been discovered during and since the War. Though it has probably occurred before, in England perhaps in 1685, it was not recognized until 1917. It is one of a group of diseases to which cerebrospinal fever and poliomyelitis belong, in which the pathological agent is frequently present in the human being without causing an attack of the disease until the balance between the virulence of the virus and the immunity of the individual goes in favour of the virus. It is probable, too, that as was found in the case of cerebrospinal fever, an epidemic does not occur until the carriers reach a definite percentage—in the case of cerebrospinal fever about 20 per cent. A far more common and important condition is avitaminosis, and we are indebted to the Great War for a great deal of our present knowledge of its effects and treatment, even if unhappily much of it has come from study of the effects of starvation of children in beaten countries and of prisoners of war.

In anaesthetics the use of local injections was popularized, and the unfavourable after-effects of long ether anaesthetics were recognized as well as the important advantages of nitrous oxide, already well known in the United States, but very little in Great Britain and Australia.

Apart from a chronological survey of the benefits arising from war, it is well recognized what a difference has been made to life in the tropics by the efforts of Army surgeons. Most of the insect vector discoveries are a result of military organization, and the methods of avoidance of tropical

diseases are due to military hygienists. Malaria, one of the greatest causes of illness and death in modern history, a determining factor in the history of the world, the cause—partial at least—of the decay of Greece and Rome owing to the slow but steady infection with the malignant tertian variety, the cause of the disappearance of the Moghul empire and the kingdom of Ceylon and the winner of many wars, was found by Laveran to be caused by a plasmodium. In 1897 Koss, labouring in the face of official opposition, discovered its transference to man by the anopheles mosquito, and opened the way to its prevention, while the Spanish conquests in South America had in the time of Ferdinand and Isabella brought quinine back to Europe.

Yellow fever, for centuries the cause of fearful mortality in the Americas, was found by Major Reed to be due to the *Stegomyia* mosquito. Gorgas, who later made the Panama Canal possible by his fight with malaria, in eight months in 1901 freed Cuba of yellow fever by attacking the *Stegomyia* and isolating fresh cases, and this successful eradication started by Army surgeons has been widely and successfully adopted for both yellow fever and malaria.

Rogers, another Army surgeon, was responsible for the valuable hypertonic treatment of cholera which has saved many lives, a method applicable to the heat cramps occurring in hot mines when water is drunk too freely, and to the loss of chlorides in intestinal obstruction.

One of the great health problems of life in the tropics has always been the effects of high solar temperature which manifest themselves in different forms commonly known as heat exhaustion, heat stroke and sunstroke. There has always been a great deal of confusion as to the exact meaning of these terms. An excellent opportunity of controlled investigation in the mass presented itself in Mesopotamia, and, while it cannot be said that finality has been reached, a great deal has been learned on the subject and a number of empiric beliefs have been demolished. Of still more importance has been the recognition of certain premonitory symptoms of heat stroke which, if followed promptly by the methods of treatment there worked out, has brought about the position that fatal results can almost always be avoided. With this let me bring the account of the benefits of war to a close, though the field has but been skimmed.

Enough has been said, I think, to establish my thesis that medical science and practice have had through the ages much for which to be grateful to war. Let us hope for an era when progress may be equally rapid without the evils of war.

If now we turn to the other side of the picture and ponder on the benefits of medical progress to war, we are brought up by the wonderful amount of knowledge now available to a commander in the field to keep his army intact as compared with the general of all past ages. As many wars and battles, if not more, have been decided by disease than by force of arms. Let us mention some of the most striking out of the many. Sennacherib, the Assyrian, in the eighth century B.C., with his host was

struck by the "Angel of the Lord" so that in a night he lost 150,000 men and was forced to depart. Probably this was some epidemic. When Xerxes was marching on Greece with an army of 800,000, the Greeks were saved by an epidemic—perhaps plague and dysentery—which attacked him and which forced him to return to Persia, without fighting, with less than half a million men.

The Crusades furnish perhaps the most dramatic known instances of disease. The first, in 1098, gives us a force of 300,000 besieging Antioch and then Jerusalem, reduced in two years to some 20,000 almost entirely by disease. Of half a million who set out on the second Crusade, disease accounted for all but a handful, if any, who returned to Europe. Plague, and not the Saracens, prevented the fourth Crusade from reaching Jerusalem. In more recent times the French in Haiti lost 22,000 out of 25,000 men, enough to allow the negroes to turn them out of the island, while the English at Cartagena, in one of the hopelessly mismanaged expeditions that distinguished our military history of the eighteenth century, lost nine out of every ten men that set out. The failure of the Walcheren expedition from malaria is perhaps the best-known example of this kind in English history.

In these and other examples of disease-won campaigns it is not always possible to identify the epidemic, but the chief killers we recognize have been plague, smallpox, typhoid, typhus, malaria, dysentery and possibly influenza. Of plague, which in the fourteenth century destroyed perhaps twenty-five million people in Europe, we now know the cause and how to prevent, if not to cure it. Smallpox we can more actively and easily control, given the time and material. Dysentery, too, with much trouble can be checked, but influenza, whether of recent or ancient origin, is beyond our powers both of prevention and treatment, and this alone of all great epidemic diseases caused more loss of human life in the great world epidemic of 1918 than did battle casualties in the Great War. The control of typhoid and malaria I have laid claim to as largely a result of war.

In the view of many typhus fever has been the greatest killer in history. It has decided wars, ended them without decision, and prevented wars, yet war did nothing to rid mankind of this scourge. Not until 1909 was it demonstrated by Nicolle that the louse was the carrier of typhus, the knowledge that the virus lay in the *Rickettsia* bodies and that in some circumstances the rat flea could act as host for the virus following in the ensuing years. It appears most probable that typhus fever came from the East to Europe. When it first made its appearance is conjectural; with the lack of medical knowledge of the early middle ages this is not surprising, for the disease does not display particularly distinguishing characteristics. Even in present times it remains undiagnosed. In 1898 a disease known as Brill's disease appeared in the north-east of the United States of America and continued for twenty-eight years before it was recognized as typhus by a doctor who was familiar with its manifestations

in Europe. Then, too, in early times the descriptions of epidemics of obviously more than one disease make their recognition nearly impossible. It has been thought by some that the Athenian fever of the Peloponnesian War was typhus, but this cannot be regarded as proven. The first description of an epidemic which can reasonably be recognized as typhus was in 1083 in Italy, and it is not again in evidence till the end of the fifteenth century. Its first known great political effect was in 1528, when it caused the abandonment of the siege of Naples by the French and brought the Papal State under the dominant influence of Spain and thus altered the subsequent history of Europe. From that time onwards we find it a companion of the constant wars that ravaged Europe for the ensuing centuries, playing a greater part than the arms of the combatants in slaying friend and foe, frequently deciding the issues between the warring States and decimating the unfortunate civilians.

It is a remarkable and largely unexplainable phenomenon that in the last and greatest of wars, with the exception of the outbreak in Serbia in the early months which so checked the Austrians in their invasion, the disease was practically non-existent in the millions fighting in Western Europe. The louse was as constant as in other wars, and the cause of other diseases, but for some unknown reason typhus did not appear in circumstances so favourable for its spread.

Had it done so, the discoveries of medicine had placed in the hands of the Armies the knowledge to control the ravages of the disease so apparent in the past, even if not yet to cure it. Perhaps a cure may result from other wars.

But apart from disease medical knowledge has done much to prevent that all-important loss of man-power by teaching what is necessary in the constitution and amount of the soldier's food ration if he is to maintain his strength and resistance to fatigue, loss of morale, and disease. Scurvy has been banished, the voyages of Captain Cook being not without influence in this achievement, and beri-beri and pellagra, which became almost universal in the Turkish Army in Syria in 1918, can be avoided. None the less proper clothing, amusement, rest and cover from the elements such as of old were deemed necessary for his steed or hound and not for his men, are now by experience and precept as great a necessity for a true commander as are training and munitions. For this, medicine must take some credit. And, last of all, prevention of sepsis in wounds, however perfect by empiric knowledge, could never have persisted had not its true cause been patiently and certainly unveiled.

Perhaps some day we may traverse the path of learning still further and find what manner of disease it is that causes man to go to war on man.

ACKNOWLEDGMENTS.

My thanks must be expressed to many of my professional brethren who have discussed this subject with me and helped me greatly with suggestions and references to literature.